A tiny duck (*Sibirionetta formozovi* sp. nov.), a giant grey partridge (*Titanoperdix felixi* gen. et sp. nov.), a new rail (*Porzana payevskyi* sp. nov.), and other birds from the Early Pleistocene of Baikalian Siberia

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Abstract

The paper describes fossil birds from the Early Pleistocene (Gelasian) of Malye Goly locality in the Baikal area of the East Siberia (Irkutsk Region, Russia). This is the first studied bird fauna from the Early Pleistocene of the Northern Asia, shedding the first light on the early Quaternary bird associations of the Siberia. A tiny fossil duck *Sibirionetta formozovi* sp. nov. is the first fossil representative of the modern genus *Sibirionetta*, the modern endemic of Eastern Siberia. This find documents the long-time (at least since the Early Pleistocene) presence of these ducks in the region. A new large pheasant-sized phasianid bird *Titanoperdix felixi* gen. et sp. nov. is a large-sized representative of the grey partridge evolutionary lineage (Perdicini). This find is in agreement with the fact that modern relatively small grey partridges (genus *Perdix*) are phylogenetically nested within the larger-bodied pheasants. Among other birds from the locality are *Tadorna tadorna,* three other ducks (including one diving form), *Perdix* cf. *dauurica*, *Porzana payevskyi* sp. nov., Podicipedidae gen. indet., Scolopacidae gen. indet., and Corvidae gen. indet. The assemblage indicates a rather productive water body with mostly open landscapes in the vicinity. The avifauna from Malye Goly does not show any considerable affinity with the Late Pliocene avian assemblages from Southern Transbaikalia and Northern Mongolia, as well as with the Early Pleistocene bird fauna of Eastern China, and thus most likely represents a separate paleornithogeographical unit. *Porzana payevskyi* sp. nov. is one of the oldest confirmed representatives of *Porzana* s.s. in the fossil record, supporting the Asian origin of the genus and a probable out-of-Asia dispersal to North America in the Early Pleistocene.

Keywords: fossil birds, early Quaternary, Eastern Siberia, North Asia, new taxa

Introduction

The Early Pleistocene (2.58–0.74 Ma) is an important epoch in the Late Cenozoic Eurasian paleontology, marking the historical transition from ancient Neogene savanna-like vertebrate faunas to generally modern-looking, the so called "cold", associations, which continued to the Middle and Late Pleistocene (Vislobokova and Tesakov, 2013). The vertebrate faunas, which appeared in the second half of the Early Pleistocene — early Middle Pleistocene, later became the core of the Late Glacial and Holocene Northern Eurasian faunas, and have mostly been persisting until the

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Fig. 1. Map showing the location of Malye Goly paleontological site (asterisk) in Eastern Siberia.

Present. Although the evolutionary history of the Early Pleistocene Northern Eurasian mammals is generally well studied (e.g., Vislobokova and Tesakov, 2013), almost nothing is known about this stage in the evolution of bird faunas of this vast and biogeographically important region. The Early Pleistocene birds of Siberia, in particular, remain totally unknown (Zelenkov, 2013a).

In this paper we describe an association of fossil birds from the Malye Goly locality in the Irkutsk Region of Eastern Siberia (Baikalian Area; Fig. 1), which represents the only known bird fauna of the Early Pleistocene age in the Northern Asia (Sizov et al., 2017). The mammalian fauna from Malye Goly can be divided into three sub-units (labeled as Malye Goly I, II and III by previous authors) all belonging to the Early Pleistocene (Gnibidenko and Adamenko, 1976; Erbayeva et al., 2017). Birds remains were collected from the level I, which corresponds to the late Gelazian (middle part of MN 17; 2.2–2.1 Ma; Sizov et al., 2017; Tesakov, 2021). A preliminary assessment of this avian fauna (Sizov et al., 2017; Palastrova, 2022) revealed the presence of several bird taxa that are first described here in detail.

Systematic palaeontology

Class AVES
Order Galliformes
Family Phasianidae
Genus *Titanoperdix* Zelenkov, Palastrova, Martynovich et Volkova, nov.

Etymology — From titans, pre-Olympians gods of the Ancient Greek mythology, and Perdix, the modern genus of Phasianidae.

Type species — *Titanoperdix felixi* sp. nov.

Diagnosis — In the coracoid, the facies articularis clavicularis oriented transversely to the long axis of the bone and thinned craniocaudally; its cranial apex is markedly pronounced and located in the central part of the facies, the dorsocranial angle cut off, and the caudal margin distinctly concave. In cranial view, the articular surface of the facies articularis clavicularis continues slightly laterally (in the form of a short tongue). The impressio bicipitalis protrudes distinctly medially to the adjacent edge of the shaft.

Species composition — Type species only.

Comparisons — The characteristic structure of the facies articularis clavicularis (craniocaudally narrow with concave caudal margin and centrally positioned cranial apex) brings the new genus close to *Phasianus* and *Perdix* among the recent Phasianidae. At the same time, the new genus differs from both mentioned genera in the pronouncedly concave caudal margin of the facies articularis clavicularis, and a cranially well protruding apex of the facies (Fig. 2, ap). In *Phasianus*, the concavity of the caudal margin of the facies may be slightly marked, but the facies is obliquely oriented (as in many other phasianids) and the impressio bicipitalis never protrudes medially (Fig. 2, ib2), as is the case in the new genus and *Perdix*. Due to the protrusion of this impressio (Fig, 2, ib1), there

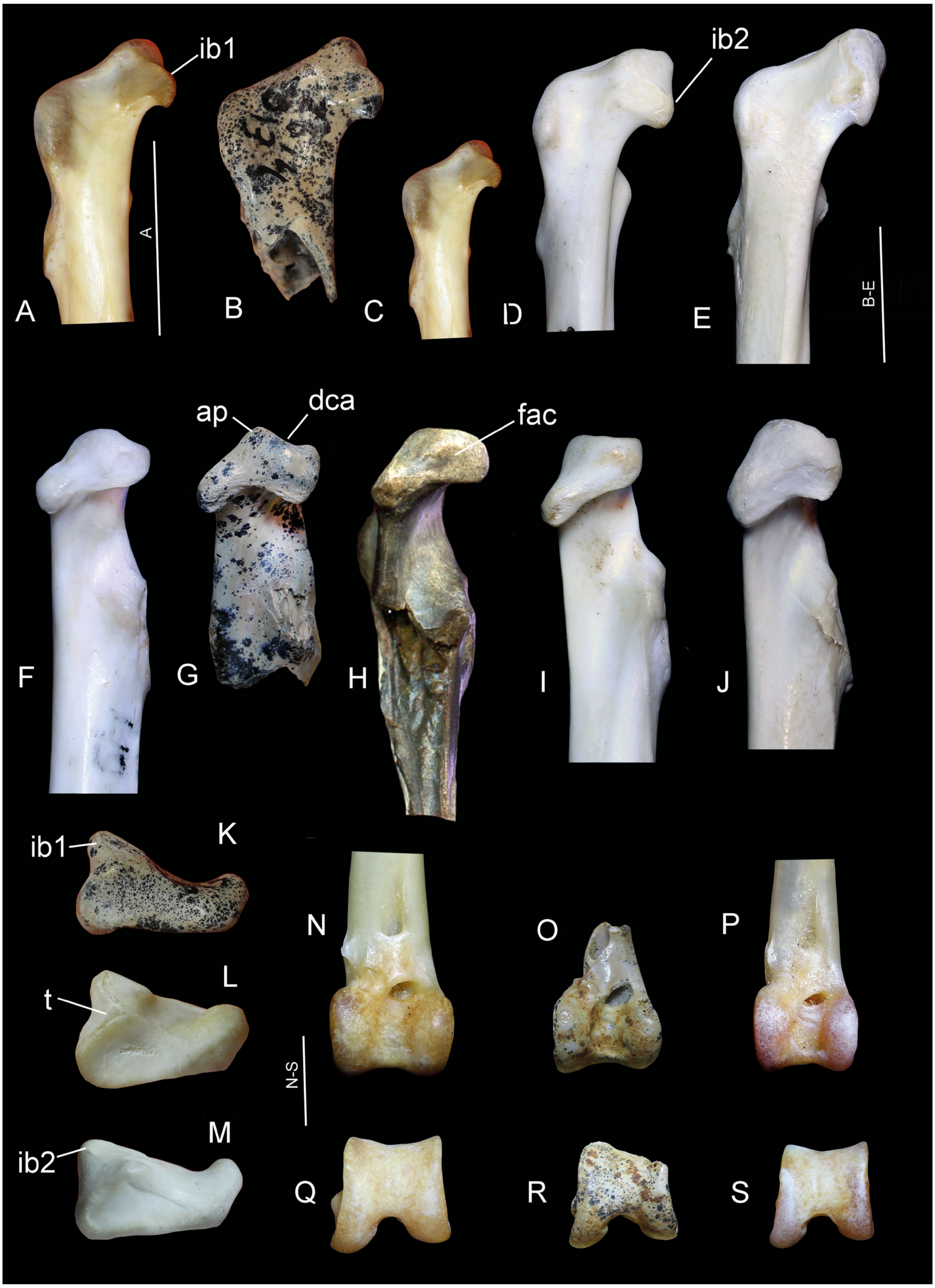

Fig. 2. Fossil phasianid birds (Galliformes: Phasianidae) from Malye Goly compared with selected modern and fossil representatives of the family: A, C, F, L, N, Q — *Perdix perdix*, modern: image A is adjusted to the same absolute size as B–E to facilitate comparisons, whereas image C is in the same scale as B-E to show true size difference between modern and fossil forms; B, G, K — *Titanoperdix felixi* gen. et sp. nov., holotype PIN, no. 2614/313, Early Pleistocene of Malye Goly; D, I, M — *Phasianus colchicus*, modern; E, J — *Tetrao urogallus*, modern; H — *Perdix inferna*, Early Pliocene of Moldova; O, R — *Perdix* cf. *P. dauurica*, specimen PIN, no. 2614/312, Early Pleistocene of Malye Goly; P, S — *Perdix dauurica,* modern. A–M — coracoids in ventral (A–E), medial (F–J) and cranial (K–M) views; N–S — tibiotarsi in cranial (N–P) and distal (Q–S) views. Designations: ap, apex of the facies articularis clavicularis; dca, dorsocranial angle of the facies articularis clavicularis; fac, facies articularis clavicularis; ib1 — impressio brachialis protruding medially relative to the medial margin of the processus acrocoracoideus; ib2 — impressio brachialis not protruding medially relative to the medial margin of the processus acrocoracoideus; t, "tongue" on the cranial surface of the processus acrocoracoideus formed by the facies articularis clavicularis. Scale bar, 10 mm. K–M — not to scale.

is a concavity between the dorsal and ventral parts of the facies articularis clavicularis in cranial view (as in *Perdix*). However, the dorsocranial margin of the impressio bicipitalis is distinctly cut (in medial view) in *Titanoperdix* gen. nov. (Fig. 2, dca), while it is not pronounced in *Perdix* (the margin is always convex or straight in this genus). The large (small pheasant-sized) Early Pliocene *Perdix inferna* (see Zelenkov and Kurochkin, 2015) is similar to modern *Perdix* in the shape of the omal part of the acrocoracoid (Fig. 2H), which indicates the stability of this part of the bone in this lineage since the Pliocene. The orientation of the dorsocranial margin of the facies articularis clavicularis, as in *Titanoperdix*, and the concavity of the caudal margin of the facies articularis clavicularis, are expressed in many Tetraonini (which are considered close relatives of *Perdix*; Kimball, Hosner, and Braun, 2021); however, a similar morphology of the processus acrocoracoideus is not observed in this group (Fig. 2E, J). The fossil genus *Palaeocryptonyx* is similar to *Perdix* in the shape of the facies articularis clavicularis in medial view (see Zelenkov, 2016c: fig. 1s), but has a non-protruding medially impressio bicipitalis (see Pavia, Gohlich, and Mourer-Chauvire, 2012: fig. 1m, n). *Palaeocryptonyx* further includes only relatively small-sized species from Europe (Pavia, Gohlich, and Mourer-Chauvire, 2012).

Remarks — The new genus is here erected for a large (the size of the male *Tetrao tetrix*) bird, partly similar in the morphology of the cranial part of the coracoid with *Perdix*, *Phasianus*, and, to a lesser degree, Tetraonini. The structure of the cranial coracoid was shown to be a relatively good diagnostic feature in Phasianidae (Zelenkov and Panteleyev, 2015). In the overall morphology of the cranial coracoid, the new genus is close to modern *Perdix*. The distinct morphology of the processus acrocoracoideus, observed in the new genus (see above), is however not found in the aforementioned taxa and indicates the existence of a separate lineage of large phasianid birds in the Early Pleistocene of Siberia.

Titanoperdix felixi Zelenkov, Palastrova, Martynovich et Volkova, sp. nov.
Fig. 2B, G, K

Etymology — The species is named in honor of zoologist Felix Ya. Dzerzhinsky (1937–2015), a former professor at the Moscow State University and the academic teacher of N. V. Zelenkov, N. V. Martynovich and N. V. Volkova.

Holotype — PIN, № 2614/313, cranial fragment of a right coracoid.

Type locality and horizon — Malye Goly 1; Baikal Area, Russia; Lower Pleistocene, middle Gelazian (MN 17; MNR1).

Diagnosis — As for the genus.

Dimensions, in mm — The length as preserved, 20.0; width from the apex of labrum glenoidale to the medial apex of the processus acrocoracoideus, 12.9; dorsoventral width of the apex of the processus acrocoracoideus, 8.2.

Description and comparisons — See the diagnosis and comparisons for the new genus above.

Genus *Perdix* Brisson 1760
Perdix cf. *P. dauurica* (Pallas, 1811)

Material — Specimen PIN № 2614/312, distal fragment of a right tibiotarsus.

Remarks — The tibiotarsus can be attributed to *Perdix* on the basis of size and the general outline of the distal end and its expansion with relatively shortened condyles: in *Bambusicola* and *Galliperdix*, which are similar in size to *Perdix*, the condyles are elongated and the distal end looks mediolaterally compressed. Tetraonini (and, in particular, the closely sized *Tetrastes*) have an even more extended tibiotarsus and a scar on the pons supratendineus that is moved away from the lateral condyle.

The tibiotarsus differs from the materials on the fossil species *P. margaritae* Kurochkin, 1985 from the Late Pliocene of Shaamar locality (Northern Mongolia; Zelenkov and Kurochkin, 2009, 2015) by its smaller size. The described specimen is well comparable with the modern Daurian Partridge (*P. dauurica*), but its exact species attribution cannot be confirmed due to the limited diagnostic value of the distal tibiotarsus in Phasianidae. The divergence time of *P. dauurica* has been estimated as 1.67–2.33 Ma (Bao et al., 2010), which corresponds with the age of the Malye Goly 1 locality (Tesakov, 2021). The remains of the Daurian Partridge are also reported from the Early Pleistocene locality Choukoutien 18 in China (Hou, 1993).

Order Anseriformes
Family Anatidae
Subfamily Anatinae
Tribe Tadornini
Genus *Tadorna* Boie, 1822
Tadorna tadorna Linnaeus, 1758

Material — PIN № 2614/324, distal part of a right humerus.

Remarks — Specimen PIN, no. 2614/324 is comparable in size and the overall morphology with small geese (*Branta*) and Tadornini. It however differs from *Branta* in the narrowness of the distal end in distal view, as well as in that the fossa brachialis is narrow and positioned close to the tuberculum supracondylare ventrale. Also, the imprints of the pronator muscles in geese are set apart. In these characters the specimen is similar to *Tadorna* and, in particular, to *T. tadorna*. *T. ferruginea* is distinguished by a slightly protruding distally condylus dorsalis, a higher impressio tuberculum supracondylare ventrale, and, in general, a larger size. Based on these differences, assignment to the fossil species *T. petrina*, which is morphologically rather close to *T. ferruginea* and belongs to the lineage of Ruddy Shelducks (Kurochkin, 1985; Zelenkov, 2022), seems unlikely.

Tribe Mergini
Mergini gen. indet. (?*Bucephala* sp.)

Material — PIN № 2614/328, incomplete left humerus; PIN № 2614/325, distal fragment of a right tibiotarsus.

Remarks — The partial humerus is too fragmentary for a precise identification but agrees with Mergini in the curvature of the preserved part of the shaft, the relative position of the crista deltopectoralis and the distal end of the crista bicipitalis, the shape of the impressio for the m. deltopectoralis on the cranial surface of the bone, as well as the position of the crus dorsale fossae. In size, the specimen corresponds with the middle-sized specimens of *Bucephala clangula* or *Clangula hyemalis*. The fossil specimen is characterized by a rather sharp caudal shaft ridge, which occurs as an individual variation in modern *B. clangula*.

The distal tibiotarsus is a poorly diagnostic element in Anatidae. In the general morphology, the specimen PIN № 2614/325 is closest to modern *Bucephala* and *Mergus,* which have a similar distal tibiotarsus. In size, it corresponds to the living *M. serrator* and larger specimens of *B. clangula*.

Based on shared similarities with *Bucephala* in both presented elements it is considered likely that the fossil diving duck from Malye Goly may represent this modern genus. If correctly attributed, this find may belong to the fossil species *B. cereti* Boeuf et Mourer-Chauviré, 1992 from the roughly coeval (~2.2 Ma; MN 17; Boivin et al., 2010) locality of Chilhac in France (Boeuf and Mourer-Chauviré, 1992), where it is associated with *Tadorna tadorna*, as is also the case for the Malye Goly avifauna.

Tribe Anatini
Genus *Sibirionetta* von Boetticher, 1929
Sibirionetta formozovi Zelenkov, Palastrova, Martynovich et Volkova, sp. nov.
Fig. 3A, C, H, I

Etymology — The species is named in honor of zoologist Nikolay A. Formozov, a former professor at the Moscow State University.

Holotype — PIN № 2614/317, right coracoid.

Type locality and horizon — Malye Goly 1; Baikal Area, Russia; Lower Pleistocene, middle Gelazian (MN17; MNR1).

Diagnosis — A very small species of *Sibirionetta*, differing from the living *S. formosa* by a distinctly smaller size and poorly developed (shallower) concavity in the dorsal part of the sulcus m. supracoracoidei.

Description — The processus acrocoracoideus is craniocaudally elongated and very slightly deviates medially by its apex; in the dorsal part of the sulcus m. supracoracoidei there is a shallow fossa extending under the dorsal part of the facies articularis clavicularis (the latter overhangs it); in its ventral half, the facies articularis clavicularis protrudes relative to the adjacent medial surface of the shaft, but does not overhang it; the impressio bicipitalis is slightly displaced medially relative to the adjacent edge of the bone shaft; the cotyla scapularis is small, subtriangular, located in the lateral part of the shaft; the angulus medialis lacks a cranial crest.

Dimensions, in mm — The least transverse shaft width, 3.5; dorsoventral width of the apex of the processus acrocoracoideus, 4.2.

Comparisons — An almost complete coracoid belongs to a very small duck, comparable in size to the smallest known Anatidae, such as the modern *Nettapus* spp. or fossil *Mioquerquedula* spp. It is noticeably smaller than *Anas crecca*, the smallest duck in the modern fauna of Eurasia, and is further morphologically distinct from this species and another small Eurasian duck *Spatula querquedula*. The specimen is here assigned to *Sibirionetta* (Fig. 3A, C, D) by the presence of an elongated and not shifted medially processus acrocoracoideus, as well as by the presence of a fossa in the dorsal part of the sulcus m. supracoracoideus overhanged by the dorsal half of the facies articularis clavicularis. The depression in the dorsal part of the sulcus m. supracoracoidei may also be present in *Anas* s.s. and *Spatula* ducks. However, in *Anas* s.s., the facies articularis clavicularis always does not overhang the sulcus m. supracoracoidei and the aforementioned depressio in the dorsal part of the sulcus; and the processus acrocoracoideus is shorter. In *Spatula*, the pit in the dorsal part of the sulcus m. supracoracoidei also does not extend under the facies articularis clavicularis. The fossa, similar to *Sibirionetta*, is often present in *Mareca* ducks, but in general morphology, the coracoid of *Mareca* is more distinct from *Sibirionetta* than other mentioned genera (Fig. 3F): the cotyla scapularis is large and located closer to the central line of the shaft; the facies articularis clavicularis in most cases overhangs the sulcus m. supracoracoidei along its entire length; the crest cranial to the angulus medialis is always pronounced; and the processus acrocoracoideus clearly protrudes medially, so that the impressio bicipitalis is exposed medially to the adjacent edge of the shaft. The general outline of the coracoid is markedly more robust in *Mareca*, while it is slender in *Sibirionetta formosa* and the new fossil species; the crest on the angulus medialis may be absent as an individual variation in *S. formosa* (as in the new species).

Anatini gen. indet. 1

Material — PIN № 2514/318, incomplete left scapula.

Remarks — The scapula belongs to a rather small duck that is notably larger than *S. formozovi* sp. nov. and somewhat larger than the living *A. crecca*/*S. querq-*

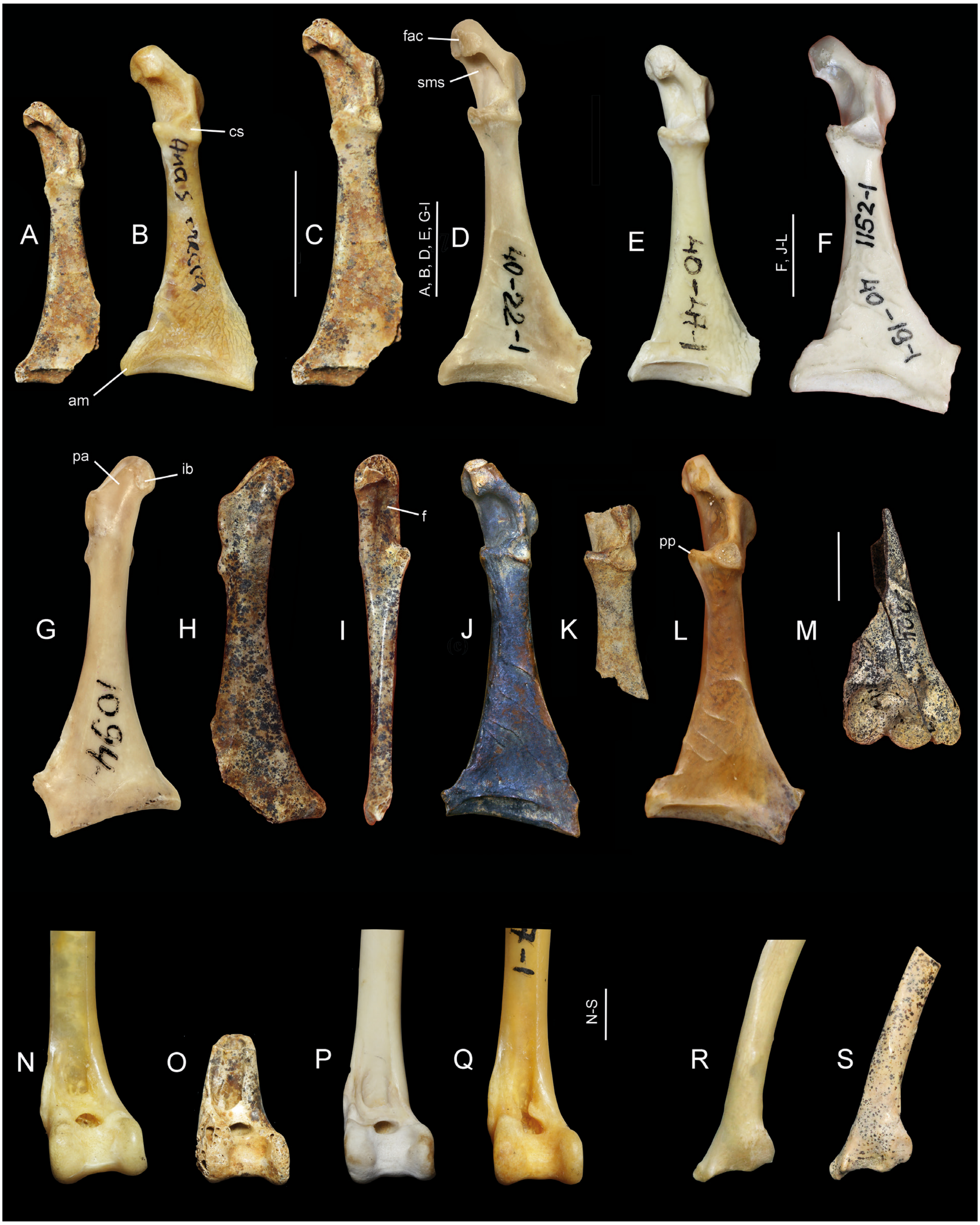

Fig. 3. Fossil anatid birds (Anseriformes: Anatidae) from Malye Goly compared with selected modern and fossil representatives of the family: A, C, H, I — *Sibirionetta formozovi* sp. nov., holotype PIN, no. 2614/317, Early Pleistocene of Malye Goly: image A is given in the same scale as B, D–F to show true size difference between fossil and modern forms, whereas image C is adjusted to the same absolute size as B, D–F to facilitate comparisons; B, R — *Anas crecca*, modern; D, G — *Sibirionetta formosa*, modern; E — *Spatula discors*, modern; F — *Mareca sibilatrix*, modern; J — *Spatula praeclypeata*, Early Pleistocene of Taurida, Crimea (Eastern Europe); K — Anatidae gen. indet. (magn. *Spatula clypeata*), specimen PIN, no. 2614/319; L — *Spatula clypeata*, modern; M — *Tadorna tadorna*, speciemen PIN, no. 2614/324, Early Pleistocene of Malye Goly; N — *Anas platyrhynchos*, modern; O — Merginin gen. indet. (cf. *Bucephala clangula*), specimen PIN, no. 2614/325, Early Pleistocene of Malye Goly; P — *Mergus serrator*, modern; Q — *Bucephala clangula*, modern; S — Anatidae indet., specimen PIN, no. 2514/318, Early Pleistocene of Malye Goly. A–L — coracoids in dorsal (A–F, J–L), ventral (G, H), and medial (I) views; M — distal humerus in cranial view; N–Q — distal tibiotarsus in cranial view; R, S — cranial scapula in lateral view. Designations: cs, cotyla scapularis; f, fossa in the dorsal part of the sulcus m. supracoracoidei; fac, facies articularis clavicularis; ib, impressio bicipitalis; pa, processus acrocoracoideus; pp, processus procoracoideus; sms, sulcus m. supracoracoidei. Scale bar, 10 mm.

uedula. Despite fragmentary and poorly diagnostic, this specimen testifies to the presence of yet another taxon of Anatidae in the fauna of the locality. Unnamed species of the similarly-sized ducks of the genus *Anas* s.l. are known from the Late Miocene — Early Pliocene of Western Mongolia and the North Black Sea area in Eastern Europe (Zelenkov, 2012; Kovalchuk et al., 2017).

Anatini gen. indet. 2 (magn. *Spatula clypeata*)

Material — PIN No 2614/319, fragmentary left coracoid; PIN No 2614/321, cranial fragment of a left scapula.

Remarks — These remains belong to a notably larger duck, the size of modern *Spatula clypeata* and thus must be compared with the coeval Early Pleistocene *Spatula praeclypeata* from the Crimea, which constitutes the oldest fossil record of the Shoveler lineage (Zelenkov, 2022). The coracoid is however too fragmentary for a precise generic identification, and the scapula is not diagnostic enough to distinguish genera within Anatini (*Anas* s.l.). However, the cotyla scapularis is larger than in the holotype of *S. praeclypeata*, and the processus procoracoideus is thinner, and hence attribution to that fossil species is not clearly supported. In both these characters, the coracoid PIN, No 2614/319 is similar to modern *S. clypeata* (Fig. 3J–L).

Order Podicipediformes
Family Podicipedidae
Podicipedidae gen. indet.

Material — PIN No 2614/326, incomplete right coracoid.

Remarks — The specimen is characterized by the typical morphology of Podicipedidae and is similar in size with the living *Podiceps grisegena* (see Bochenski, 1994), thus being distinctly larger than the fossil *P. solidus* from the Late Miocene — Early Pliocene of Mongolia (Kurochkin, 1985; Zelenkov, 2013b; 2016a) and the Pliocene species *P. discors* (Murray, 1967) and *P. csarnotanus* (Kessler, 2009). The grebe from Malye Goly locality (Fig. 4K–O) differs from the recent *P. cristatus, P. grisegena, P. auritus* and *P. nigricollis* by a dorsoventrally narrow facies articularis humeralis and by the apex of the processus acrocoracoideus not being bent ventrally (although the processus itself is not well preserved, this condition is apparent from the shape of the impressio lig. acrocoracohumeralis, whose cranial apex is not curved ventrally). This morphological peculiarity indicates that the grebe from Malye Goly most likely represents a distinct extinct taxon, but it is too poorly preserved for a formal description. Closely-sized fossil taxa *Podiceps parvus, P. arndti* and *Aechmophorus elasson* were described from the Pliocene of North America (Wetmore, 1937) and should be compared with the taxon from Malye Goly.

Order Ralliformes
Family Rallidae
Genus *Porzana* Vieillot, 1816
Porzana payevskyi Zelenkov, Palastrova, Martynovich et Volkova, sp. nov.
Fig. 4C, E, H

Etymology — The species is named in honor of ornithologist Vladimir Payevsky of the Zoological Institute of the Russian Academy of Sciences.

Holotype — PIN № 2614/327, incomplete right coracoid.

Type locality and horizon — Malye Goly 1; Baikal Area, Russia; Lower Pleistocene, middle Gelazian (MN17; MNR1).

Diagnosis — A large species of *Porzana*, larger than the living *P. porzana* and fossil *P. botunensis* Boev, 2015 and comparable with *Rallus aquaticus* in absolute dimensions. It further differs from *P. porzana* by a more elongate shaft.

Description — The processus acrocoracoideus is gracile and does not protrude significantly medially relative to the adjacent medial margin of the shaft; impressio bicipitalis is in line with the longitudinal axis of the processus and does not protrude medially; the medial margin of the shaft is moderately concave; the foramen n. supracoracoidei is slit-like and moderately offset from the processus procoracoideus; processus medialis near the medial angle of the bone is absent.

Measurements (in mm) — Length of the cranial end from apex of the processus acrocoracoideus to the caudal margin of the cotyla scapularis, 5.7; length as preserved, 20.2; least transverse shaft width, 2.2; mediolateral width of the processus acrocoracoideus, 3.5; dorsoventral width of the apex of the processus acrocoracoideus, 3.2.

Comparisons — The holotype coracoid is here assigned to the genus *Porzana* s.s. due to the characteristic concave profile of the medial margin of the shaft and the gracile processus acrocoracoideus (Fig. 4C, D, H, I). The former character distinguishes *Porzana*, closely related *Fulica* (and apparently constitutes a synapomorphy of this clade) and additionally *Crex* from all other rails (Zelenkov, Panteleyev, and De Pietri, 2017). The genus *Crex*, however, may be easily distinguished from the new form by a medially protruding impressio bicipitalis and a peculiar outline of the proximal profile of the coracoid (see Zelenkov, Panteleyev, and De Pietri, 2017: fig. 4z). The gracile processus procoracoideus is a characteristic feature of *Porzana*. The elongate shaft makes the described coracoid closer to the species of *Rallus*, but the latter genus is easily distinguished from *Porzana* by a well-developed processus medialis (Fig. 4, pm), which is absent in the new taxon and species of *Porzana*. The elongate shaft is also present in *P. piercei* from the Pleistocene of Bermuda (Olson and Wingate, 2000).

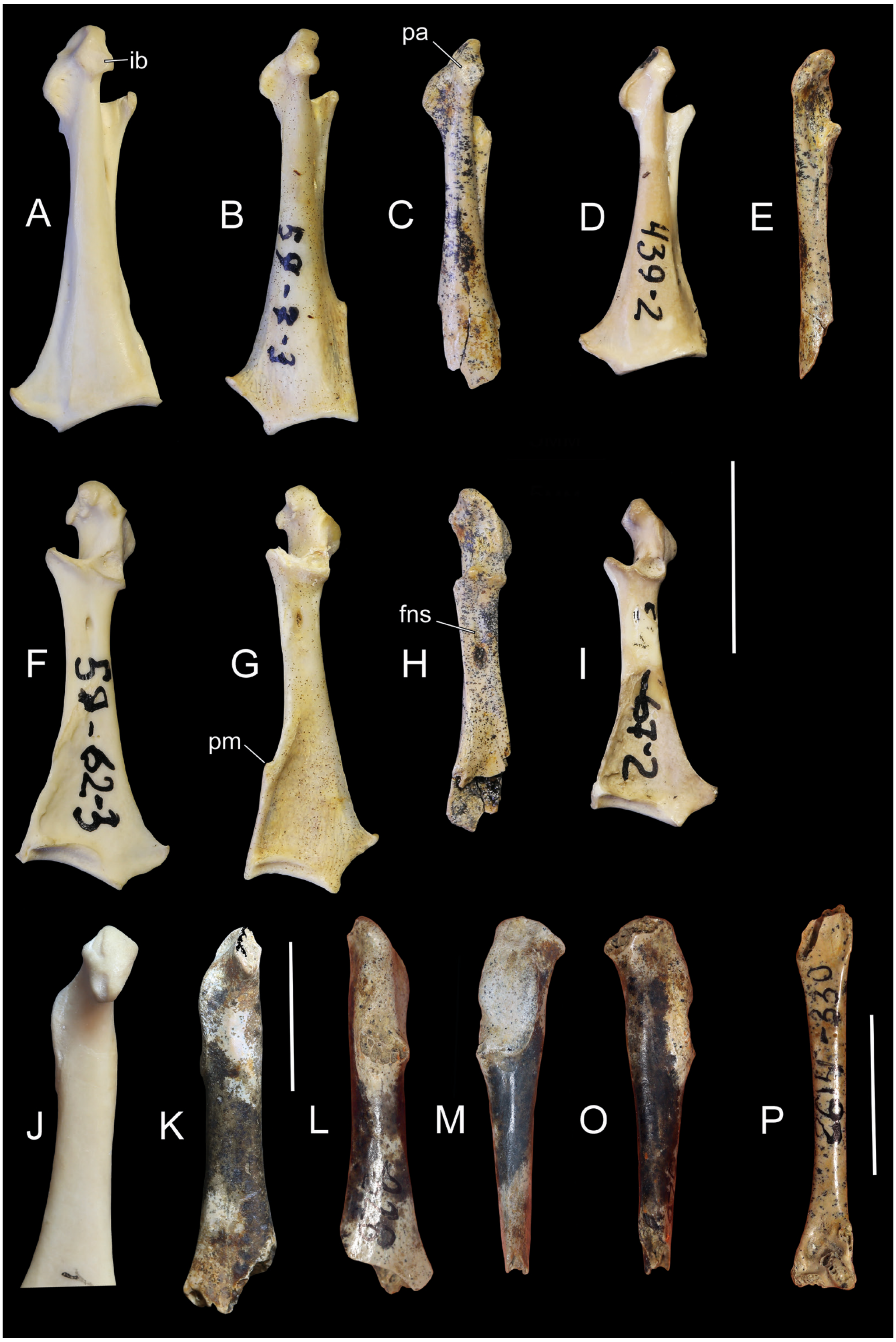

Fig. 4. Fossil rallid (Ralliformes: Rallidae), podicipedid (Podicipediformes: Podicipedidae) and scolopacid (Charadriiformes: Scolopacidae) birds from Malye Goly compared with selected modern and fossil representatives of the family: A, F — *Crex crex*, modern; B, G — *Rallus aquaticus*, modern; C, E, H — *Porzana payevskyi* sp. nov., holotype PIN, no. 2614/327, Early Pleistocene of Malye Goly; D, I — *Porzana porzana*, modern; J — *Podiceps grisegena*, modern; K–O — *Podicpes* sp., specimen PIN, no. 2614/326, Early Pleistocene of Malye Goly; P — Scolopacidae gen. indet., specimen PIN, no. 2614/330, Early Pleistocene of Malye Goly. A–O — coracoids in ventral (A–D, J, K), medial (E, O), dorsal (F–I, L), and lateral (M) views; P — humerus in cranial view. Designations: fns, foramen nervi supracoracoidei; pa, processus acrocoracoideus; pm, processus medialis. Scale bar, 10 mm.

Remarks — Previously, a number of small-sized Neogene taxa of rails were described within the modern genus *Porzana* s.l. (Boev, 2015; Zelenkov and Kurochkin, 2015). However, the traditional treatment of this polyphyletic genus is now challenged (e.g., Garcia-R, Gibb, and Trewick, 2014; Garcia-R, Lemmon, Lemmon, and French, 2020; Kirchman et al., 2021) and, in particular, several Palaearctic species, which were used as osteological reference, are now classified within a distinct genus *Zapornia*. This questions the generic attribution of the fossil species described within the traditional genus *Porzana*. It was shown (Zelenkov, Panteleyev, and De Pietri, 2017) that *Zapornia* rails, which are not close relatives of *Porzana*, indeed show a distinctive osteology and, in particular, have a different structure of the coracoid. Two fossil species, *Porzana veterior* and *P. kretzoii*, from the Late Miocene of Hungary were moved to *Zapornia* due to the characteristic morphology shared with this modern genus (Zelenkov, 2017). Other alleged Miocene and Early Pliocene members of *Porzana* await taxonomic revision.

The fossil *P. botunensis* Boev, 2015 from the Early Pleistocene (MN 17) of Bulgaria is another confirmed species of *Porzana*; it is the same size as the living *P. porzana* (Boev, 2015) and thus is smaller than *P. payevskyi*. Importantly, *P. botunensis* and *P. payevskyi* are the oldest confirmed finds of *Porzana* in the fossil record in Eurasia, dating to approximately 2.2–2.1 Ma. In North America, the modern species *P. carolina* is reported from the somewhat younger (~1.8 Ma; Bell et al., 2004) sediments of Inglis 1A locality in Florida (Emslie, 1998), which may indicate an out-of-Asian dispersal of this lineage to North America in the Early Pleistocene. Recently Boev (2015) noted the late appearance of *Porzana* rails in the fossil record of North America and thus supposed the Old-World origin of this genus (though this author apparently considered the traditional polyphyletic meaning of *Porzana* in his evolutionary discussion). The lack of older fossils does not support a more ancient (middle Miocene) divergence of the American *P. carolina* and Eurasian/Australian species as inferred from previous molecular data (Garcia-R, Gibb, and Trewick, 2014; see also Garcia-R, Lemmon, Lemmon, and French, 2020). Importantly, the Late Miocene European assemblages of rails do not include members of *Porzana* (Zelenkov, 2017; Zelenkov, Panteleyev, and De Pietri, 2017), and the Early Miocene European assemblages are even composed of non-rallid ralliform birds (De Pietri and Mayr, 2014). The fossil record thus better agrees with the recent molecular inference, which dates the divergence of *Porzana* s.s. to the Miocene–Pliocene boundary (Kirchman et al., 2021).

Order Charadriiformes
Scolopacidae gen. indet.

Material — PIN 2614/330, distal fragment of a left humerus.

Remarks — The specimen represents a small-sized charadriiform bird, which can be distinguished from Charadriidae by a deeper fossa brachialis, and from Glareolidae — by a longer processus flexorius. In the overall morphology and size, the specimen is close to *Phalaropus eleonorae* of the Late Pliocene of Northern Mongolia (Kurochkin, 1985; Zelenkov and Kurochkin, 2015) or recent *Actitis hypoleucos*, but is too fragmentary for precise identification.

Order Passeriformes
Corvidae gen. indet.

Material — PIN 2614/292, distal fragment of a left ulna.

Remarks — The specimen is morphologically and dimensionally close to the living *Corvus monedula* but is too fragmentary for a more precise identification.

Discussion

The avian fauna from Malye Goly locality at the Baikal region, dated to about 2.2–2.1 Ma, is the first described association of fossil birds from the Early Pleistocene of Siberia, and the entire Northern Eurasia in general. The early Quaternary avian faunas are generally well represented in Southern and Central Europe (Tyrberg, 1998; Mlíkovský, 2002), but remain practically unknown from the more northern regions (see Panteleyev, 1999; Zelenkov, 2013a). Previously, the oldest published Quaternary avian fauna from Siberia was that from the latest Middle Pleistocene (ca. 0.28–0.15 Ma) layers of Denisova Cave at Altay mountains in Southern Siberia (Panteleyev, 2002; Martynovich, 2004); this avifauna was already very close to the well-studied Late Pleistocene (and, eventually, the Present day) assemblages of the region. In contrast, the birds from Malye Goly are taxonomically distinct from the recent fauna, thus clearly representing a different stage in the evolution of Eastern Siberian birds. The avifauna from Malye Goly may be compared with the Late Pliocene (ca. 2.6 Ma) faunas from the southern Transbaikalia (especially the locality Beregovaya) and adjacent Northern Mongolia (locality Shaamar; Kurochkin, 1985; Zelenkov, 2016a). These sites are however located significantly further south and are currently positioned in the steppe zone of northern Central Asia, whereas Malye Goly locality is now located in the naturally forested Tayga environmental zone (with irregular patches of steppe in river valleys). The Early Pleistocene avifauna from the Choukoutien 18 site in Eastern China is also composed of the open-land steppe species (Hou, 1993; Tyrberg, 1998) and thus is poorly comparable with the fauna of Malye Goly, which mostly includes waterbirds. The geographically closest ancient bird fauna from the studied area is that from Tagay locality at Baikal Lake, belonging to the latest Early Miocene and representing a much older epoch of the warm Miocene Climatic Optimum (Zelenkov, 2016a, 2016b; Volkova, 2020).

The avian assemblage from Malye Goly comprises taxa which are close to modern ones (e. g., *Perdix* cf. *dauurica*, *Tadorna tadorna*) with morphologically peculiar or extinct taxa (e. g., *Titanoperdix felixi* gen. et sp. nov., *Sibirionetta formozovi* sp. nov.), which clearly indicates the general antiquity of this fauna relative to the late Quaternary avifaunas of the region. However, any significant continuity with the Late Pliocene avian faunas of the Central Asia is not traceable. The lineage of grey partridges (*Perdix*) is represented by different species in the Late Pliocene faunas of Northern Mongolia/Transbaikalia, where a larger fossil species *P. margaritae* is present (Kurochkin, 1985; Zelenkov and Kurochkin, 2009), and the Early Pleistocene of Malye Goly. Yet the presence of *Perdix* cf. *dauurica* likens the assemblage from Malye Goly with the Choukoutien 18 locality in China, but otherwise the two faunas are different (Hou, 1993; Tyrberg, 1998). The genus *Tadorna* is present in both Malye Goly and the discussed Late Pliocene sites but is represented by different lineages: *Tadorna petrina* from Beregovaya (and Crimea in Eastern Europe) belongs to a separate group of Ruddy Shelducks, morphologically well-distinct from the more ancient Common Shelduck *T. tadorna* of Malye Goly (Kurochkin, 1985; Zelenkov, 2022). Both Ruddy and Common Shelducks are characteristic of the present-day arid faunas of Central Asia, and the paleontological data thus indicate their long-time persistence in this geographical region. The systematic position of the grebe from Malye Goly is unclear but its morphological distinctiveness from the Pliocene and modern Eurasian species is notable.

The most interesting taxa in the new fauna are a tiny duck *Sibirionetta formozovi* and a large phasianid *Titanoperdix felixi,* likely representing the North Asian Early Pleistocene endemics. The genus *Sibirionetta* includes the only living species Baikal Teal (*S. formosa*), which breeds on various lowland lakes (from steppe to tundras) in East Siberia. This species was found as fossil in the terminal Late Pleistocene — early Holocene of Yakutia in Eastern Siberia and Krasnoyarsk area in the southeast of West Siberia (Ovodov and Martynovich, 1999; Martynovich, 2004; Zelenkov, 2008; Zelenkov et al., 2008; Martynovich, 2013a; Martynovich and Ovodov, 2014) and in the late Holocene (17th century AD) of the Northwestern Siberia (Martynovich, 2013b; Kosintsev and Lobanova, 2015). The presence of a miniature fossil species in the Early Pleistocene of Eastern Siberia sheds the first light on the early evolution of the genus *Sibirionetta*. It is unclear whether the fossil taxon *S. formozovi* represents an ancestor or a sister-species of the living *S. formosa*, but the very small size of *S. formozovi* is intriguing, as it links this fossil species with the fossil middle Miocene *Mioquerquedula* spp. (Zelenkov and Kurochkin, 2012) and modern *Nettapus* spp. and *Anas hottentota*, now inhabiting tropical environments. No such small species of Anatidae were previously found in the cold Quaternary faunas. The unusually small size of *S. formozovi* may indicate a warmer (supposedly subtropical) origin of this endemic North Asian lineage.

Titanoperdix felixi is a large pheasant-sized phasianid bird, morphologically close, as can be judged from the structure of the coracoid, to the modern genus of grey partridges (*Perdix*). The living grey partridges are rather small birds, but a larger fossil species (*P. inferna*) is known from the Pliocene of Central Asia and Eastern Europe (Zelenkov and Kurochkin, 2015). *Titanoperdix felixi* is an even larger bird than *P. inferna*, indicating that the small size of modern *Perdix* is obviously a secondary trait. This agrees with the phylogenetic inference, which positions the genus *Perdix* among the larger-sized pheasants (Kimball, Hosner, and Braun, 2021). The phylogenetically basal species *Perdix hodgsoniae* (Bao et al., 2010) is found in the highlands of Central Asia (Tibet), and the oldest undoubted fossil species (*P. margaritae*) is also known from the Central Asian region* (Kurochkin, 1985; Zelenkov and Kurochkin, 2009). The find of *Titanoperdix* adds further support to the view that the phylogenetical lineage of grey partridges may have an Asian origin.

It should be noted that most avian taxa from Malye Goly are known from single bones, which likely indicates a rather diverse taxonomic assemblage, which will definitively increase as new material becomes available. In this regard, the diversity of waterfowl in the locality is especially remarkable and provides some information about the environmental settings at the time of the locality's formation. The rail (*Porzana payevskyi*) most likely indicates the presence of at least some patches of well-developed shoreline vegetation, while the Common Shelduck, in contrast, inhabits waterbodies with open shoreline, both rocky or arid. The predominantly sedentary grey partridge (*Perdix*) confirms the presence of open steppe-like landscapes just by the shore. The presence of large grebe and diving duck (as well as other ducks) is generally consistent with a rather productive riverine ecosystem that could provide animal food for these taxa. These data are well consistent with the previous paleoenvironmental assessment based on mammals and mollusks (Sizov et al., 2017).

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* The genus *Perdix* was also reported from two Pliocene sites in Hungary (Kessler, 2009), but these finds require confirmation and are apparently erroneous. Materials were not illustrated, and published measurements are inconsistent with the species of *Perdix* in proportions. In particular, the tarsometatarsus from the Late Pliocene Beremend 18 site (Kessler, 2009) agrees with that of modern *Alectoris* in proportions and likely belongs to this genus.

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